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ABSTRACT

This presentation reports the first phase of a multi-phase project to develop computer readiness materials for children. Materials are intended to prepare children to work with computer-assisted instructional programs. This first phase of the research involves designing and testing matrix boards, which are used to teach preschoolers and kindergarteners the parts of the computer and to reinforce concepts such as big and little, geometric figures, and colors. The matrix boards, which can be made by teachers and day care workers at low cost, are designed to be used in simple transactional games such as "Simon Says" and "Concentration." The use of these matrix boards is based on the learning principles of Bloom, Hunt, and Piaget, as well as on Moore's and Gotkin's ideas about individualized instruction which emphasize the child's taking the initiative in learning and/or taking the teacher's role with other children. The matrix boards initially used in the project were modeled on the original Gotkin Language Matrix Boards, but they were modified after a pilot test with 50 children ages 3 to 5. Appendices to the report include an example of a game matrix, a sample lesson, guidelines for transactional instructional games, and a song about the parts of the computer. (CB)

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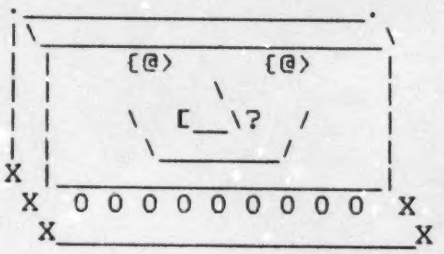

Matrix Games - An Innovative Path to Computer Literacy

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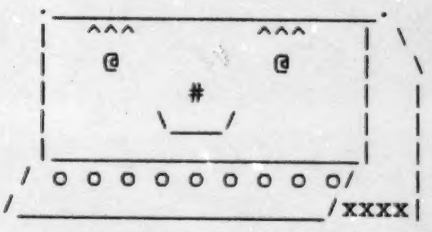

INTRODUCTION

Hello, we are Dr. Blythe Hinitz, Assistant Professor of Early Childhood Education at Trenton State College; Dr. Harlene Galen, Principal of Magowan Elementary School; and Dr. Herman Hinitz, educational consultant. The research that we are reporting today is the first phase of a multi-phase project. The project involves readiness materials designed for utilization before children work with computer assisted instructional programs. All of the materials we have developed can be made by a classroom teacher; day care worker; or a high school or college child development student, with appropriate guidance and supervision.

OVERVIEW OF PRESENTATION

The purposes of this presentation were twofold. The first was to demonstrate "gaming" as a methodology for developing young children's readiness skills for interacting with computers. The second was to show examples of low cost alternatives for teaching/learning computer skills.

We wanted the attendees to feel more comfortable teaching children about computers. Therefore, we began with word association in small groups. Each word was part of the lexicon of computer terminology. As a large group we analyzed the participants' responses to the words. These experiences set the stage for the subsequent theoretical and audio-visual presentations.

The audio-visual presentation consisted of slides and a model matrix game. (See Appendices A and B) The slides showed preschool and kindergarten children working with matrix boards, under adult guidance.

The text of the theoretical presentation and experimental work done during the Spring of 1984 is reproduced below.

SYNOPSIS OF THEORETICAL AND EXPERIMENTAL WORK

Several theorists' work served as the basis for our research. Benjamin Bloom's studies suggested that half the variation in later intelligence is evident by age four.

J. McVickar Hunt said that while benefits can be derived from early enrichment, early deprivation leads to deficits in a child's functioning. He identified The problem of the match. He explained that activities should provide a slight challenge. They should be difficult enough to require attention and effort, but not so difficult as to be impossible. This optimal degree of discrepancy is called the "match". The teacher's task in solving the problem of the match is to determine which activities or situations will be not too easy or difficult but "just right". The child will get intrinsic satisfaction from such activities. She therefore will not need to be praised, cajoled, threatened, bribed, or otherwise influenced to begin and sustain involvement with these activities. (Dopyera and Dopyera,1982,P.117)

According to Jean Piaget, humans have a need to be engaged in the processes of assimilation and accommodation, which form adaptation. This means that the teacher must find a way to

strike a balance between what the child already has in her cognitive structures, and the new material. A valid match can be made between the child's cognitive schema (thinking structures/brain) and the educational possibilities available to her. Thus, no child will experience a cultural trauma upon school entrance. A school program can be built around a valid match between the child's past experience and the educational setting provided for her. (Dopyera and Dopyera, 1982, P.153)

We utilized the work of Bloom, Hunt, and Piaget in our choice of concepts to be developed. The specific concepts used in our matrices were based on the developmental levels and experiences of the children.

O.K. Moore and fellow theorist Lassar Gotkin came from the field of programmed instruction. In their research and their work with young children they followed divergent paths. Moore developed the "talking typewriter", a machine which allowed children to solve problems. Gotkin developed transactional instructional games, which he utilized in his Interdependent Learning Model Follow Through Program. We have adapted ideas from both men's work.

Omar Kayam Moore (O.K. Moore) developed the Edison Responsive Environment, also known as the "talking typewriter". He believed that children between the ages of 2 and 5 are capable of extraordinary feats of inductive reasoning when they are left to themselves in a properly responsive environment. He utilized his formal background in programmed instruction to develop a machine which would allow the child to teach himself skills in his own way without adult interference . The Responsive

Environment consisted of a television screen, a typewriter, a tape recorder, a speaker mounted in the child's portion of the booth and a microphone for the human attendant in the back of the booth. The child was able to take the initiative. Depending on what the child had done, the environment (person and machine) simply responded in certain ways. No two programs were alike - each child faced puzzles that were programmed just for him, and that kept changing as he went along. Gradually the child who persisted made a series of interlocking discoveries about sounds, words and sentences, much in the way that a young child learns to talk.

Moore's machine is a learning machine, which contrasts sharply with a teaching machine. Teaching machines make students come up with the right answer by leading them in a straight line from one piece of information to the next. (Pines, 1967, P.94) By eliminating extrinsic rewards and lock-step progression, Moore's system gave children the opportunity to preserve a natural, inquisitive attitude. Moore's goal was to produce independent thinkers - not to stuff children with rules or facts.

Moore's "talking typewriter" was the precursor of the micro-computer. He emphasized that the coming educational revolution would be <u>individualized instruction</u>. (Pines, 1967, P.74) The presence of computers in schools for young children and the proliferation of computer assisted instruction in our nation's classrooms have borne out his prediction.

Drs. Lois Baker and Doreen Steg at Drexel University devised a methodology for using Moore's "talking typewriter". These researchers worked with three-to-five-year-old day care children

to expand their language and problem solving skills. Adult facilitators play an important role in their program. We have incorporated a variation of this aspect of the Baker/Steg technique. In the second phase of our research project, adults assist the children both in the classroom and in the computer laboratory.

Lassar Gotkin's Interdependent Learning Model emphasized transfer of control of the learning situation from the adult to the children. Learning took place in small groups where the pupils became increasingly less dependent upon the teacher and more interdependent. The teacher's role became one of giving corrective feedback, rather than telling the pupil that an answer or a method was wrong. The pupils became actively involved in figuring things out on their own, reaching mastery, and monitoring their own learning behavior. (See Appendix C)

Gotkin's model evolved as a synthesis between the programmed instruction approach and the verbal/social approach to learning and teaching.

An important part of the model was the development of transactional instructional games. Gotkin defined a game as players actively involved in play according to rules. An instructional game is one which has significant instructional value. It serves as the vehicle for presenting a variety of instructional contents and can be used for multiple instructional objectives. A transactional game is one in which children can and do take over the role of teacher and teach each other. The rule structure and materials allow young children to have greater and greater control over the learning situation. The control

rests increasingly in and among the children, rather than with the teacher. (Gotkin, references in bibliography, 1961-1970)

From our review of the literature we ascertained that the work of Bloom, Hunt, Piaget, Moore, Gotkin, Baker and Steg was most relevant to our study. Their ideas aided us in developing our theoretical framework. With this background we proceeded to design the experimental phase of our work.

The first experimental phase of our work, involving fifty children, was done in the Spring Semester of 1984. The work with both Head Start and kindergarten children began in February of that year and ended in June. The experimental work involved Head Start children at Trenton State College and kindergarten children at Magowan School in Edgewater Park, New Jersey. The Head Start children were three and four years of age. The kindergarten children were five and six years of age.

Initially the original Gotkin Language Matrix Boards were used. Most boards have 4 rows and 3 columns. The children were taught to differentiate between vertical columns and horizontal rows.

Volunteers were trained by Dr. B. Hinitz in the Gotkin methodology. This method was used with both the Gotkin and the Galen/Hinitz matrices.

During the summer of 1983 we conceived four Galen/Hinitz Matrices, based on the theoretical work of Gotkin and his associates. A model matrix was made in the Fall of 1983, using advertisements in computer magazines, and equipment catalogs. Additional matrix boards were prepared by college student volunteers during the Spring of 1984. The boards were made

according to our design and directions.

Our initial goal was to evaluate the effectiveness of our teacher-made materials in providing vocabulary to aid children in naming the parts of a computer. We envisioned this as a preliminary step, prior to children's "hands on" experiences with a computer. In programs where no computers are present, these games would serve as a readiness unit, giving the children some computer related experiences.

Pre-service teacher trainees who acted as volunteers at the Trenton State Head Start program served as facilitators for the introduction of the four Galen/Hinitz Matrices to the preschool children. Dr. Galen introduced our matrix boards to the kindergarten children. All of the children learned to use the shapes: "X"s, circles, and lines; of red, yellow, blue and green. The Galen/Hinitz boards reinforced the children's ability to follow single step and multistep (multipart) directions. The photographs on the matrices assisted the children in learning the names and appearances of various parts of the computer, including the monitor, keyboard, central processing unit and printer.

The college students and Dr. Galen wrote summaries of their observations. These summaries were utilized to evaluate both the children's knowledge of computer concepts and the appropriateness of the materials. Upon examination, our premise that interaction among or between children was an integral part of participation was substantiated. When one child found another about to make an inappropriate response, the first one either verbally corrected the second, or pointed to the correct answer on the matrix. Both

Head Start and kindergarten children enjoyed making up their own games utilizing the matrix materials. With the kindergarten children the materials were used as a training vehicle for children's assumption of the role of leader/teacher for their peers. The observers reported that both Head Start and kindergarten children found the computer matrices stimulating. These reactions contrasted sharply with those toward the Gotkin matrices.

In analyzing the summaries we were able to identify certain difficulties. For example, the children were perplexed because all the small pictures were not of the same size. Therefore, the younger children had trouble with the concepts of bigger and smaller, biggest and smallest. It was also determined that the number of rows and columns on the original boards was too numerous. In addition, our third and fourth matrices were confusing because they contained too many concepts. Furthermore, the observers noted that most of the children experienced difficulty with the computer terminology.

This analysis led to modification of the four Galen/Hinitz Matrices by the experimenters during the summer of 1984. In redesigning the matrix boards, we were careful to have clear delineation between small, medium size and large pictures. In order that each board would deal with only one concept, the number of columns was limited to three and the number of rows on each board was likewise decreased. The newer matrices were named the Hinitz/Galen boards and were incorporated in experimental phase two, beginning in September, 1984.

During the summer of 1984 additional computer games and

activities were developed. A song containing basic concepts was written.

AUDIENCE PARTICIPATION

So that you may gain a better understanding of our computer matrices and the way we introduced them to the children in our research, we will present a simulated lesson utilizing a modified matrix. Copies of the matrix and lesson script are in your handout. A copy of the matrix (See Appendix A) will now be shown on the overhead projector. We would appreciate some volunteers who would be willing to take the children's parts in the script. (See Appendix B)

Also in your handout is a sheet of guidelines for transactional instructional games (Appendix C). We will sing the Computer Song (Appendix D). Anyone who wishes a copy of the words may see us following the question and answer period at the conclusion of the presentation.

FIGURE - MODIFIED GALEN/HINITZ COMPUTER MATRIX
(Appendix A)

SCRIPT - SAMPLE LESSON USING GALEN/HINITZ COMPUTER MATRIX
(Appendix B)

GUIDELINES FOR TRANSACTIONAL INSTRUCTIONAL GAMES
(Appendix C)

COMPUTER SONG
(Appendix D)

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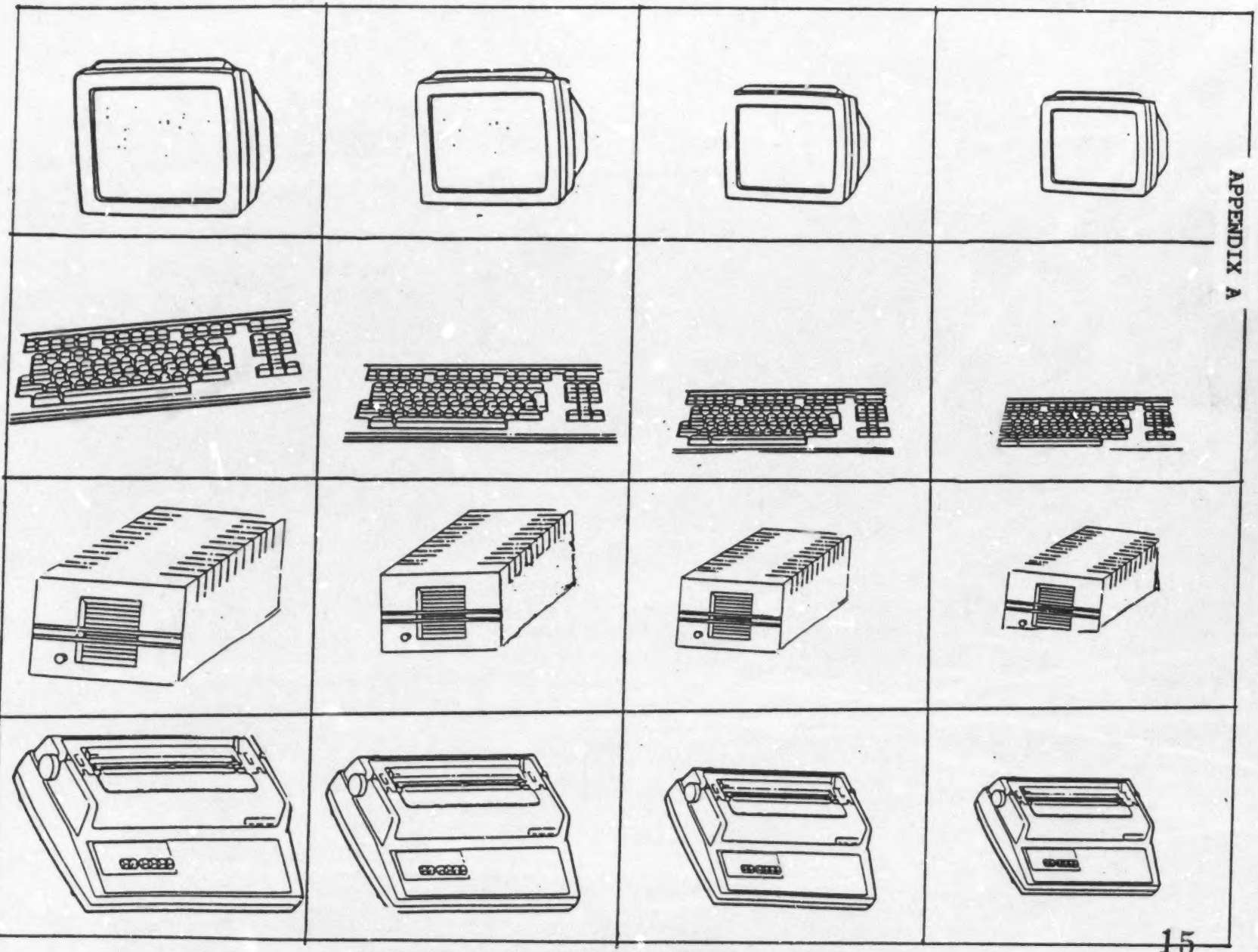

MODIFIED GALEN/HINITZ COMPUTER MATRIX

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APPENDIX B

SAMPLE LESSON USING GALEN/HINITZ COMPUTER MATRIX

Direction 1 and Teacher Option 1

Teacher: Please put the blue line on a monitor, Sally.

Sally: (Picks up a blue circle and puts it on a monitor.)

Teacher: Sally, what did you do?

Sally: I put the blue circle on a monitor.

Teacher: Good, Sally.

NOTE: THE TEACHER LET THE ANSWER STAND BECAUSE SALLY CORRECTLY IDENTIFIED WHAT SHE HAD DONE EVEN THOUGH SHE DID NOT RETAIN THE TEACHER'S DIRECTION.

Direction 1 and Teacher Option 2

Teacher: Please put the blue line on a monitor, Sally.

Sally: (Picks up a blue circle and puts it on a monitor.)

Teacher: Class, did Sally put something on a monitor?

Class: Yes, she put something on a monitor.

Teacher: Did she put a blue line on a monitor?

Class: No, she put a blue circle on a monitor.

NOTE: THE TEACHER EMPHASIZED THE CORRECT PART OF SALLY'S ANSWER FIRST AND THEN CONCENTRATED ON THE INCORRECT PART.

Direction 1 and Teacher Option 3

Teacher: Please put the blue line on a monitor, Sally.

Sally: (Picks up a blue circle and puts it on a monitor.)

Teacher: Sally, did you put the blue circle or the blue line on a monitor?

Sally: (Removes the blue circle and substitutes a blue line.)

Teacher: That's right, Sally. Please tell me what you did.

Sally: I put the blue line on a monitor.

Teacher: Let's all say what Sally did.

Class: Sally put the blue line on a monitor.

NOTE: THE TEACHER GAVE SALLY AN ALTERNATIVE CHOICE THEREBY PROVIDING THE CHILD WITH AN OPPORTUNITY TO RECOGNIZE HER ERROR AND CORRECT IT HERSELF.

Direction 2

Teacher: Please put the red X on the smallest keyboard, Keith.

Keith: (Places the red X on the smallest keyboard.)

(continued)

Teacher: Yes. Please tell me what you did.

Keith: I put it on the smallest keyboard.

Teacher: What shape is it? What color is it?

Keith: (Frowns and does not answer)(Then) It's red.

Teacher: Is it a red X or a red line?

Keith: It is a red X.

Teacher: Good, Keith. Please repeat your whole answer.

Keith: I put the red X on the smallest keyboard.
NOTE: KEITH GAVE AN INCOMPLETE ANSWER, NOT AN INCORRECT ANSWER. HE OMITTED THE NAME and COLOR OF THE SHAPE. FIRST THE TEACHER ATTEMPTED TO GIVE KEITH HELP SO THAT HE COULD SELF-CORRECT. WHEN THIS APPROACH WAS ONLY PARTIALLY SUCCESSFUL, THE TEACHER OFFERED HIM AN ALTERNATE CHOICE. Remember that an alternate choice is made up of two or more choices, one of which is the correct answer.

Important Reminder: Help the child to succeed by the methods in this sample lesson. Never tell him/her, "You are wrong." or "That's the wrong answer."

Guidelines for Transactional Instructional Games

APPENDIX C

1. The games are designed to achieve instructional objectives and require mastery of the instructional objectives to be most enjoyably and successfully played. The matrix games have specific objectives, which are defined in terms of the behavior expected from the child after she has completed the program. (Behavioral objectives)

2. The formats are simple enough that children easily grasp the rule structures by playing the games with the teacher. The teacher models the game while taking the role of player.

3. Games children already know can be adapted to instructional purposes. Gotkin used Simon Says as an example.

4. The ideal game has a format that can be adapted to a variety of instructional objectives, for example, Concentration.

5. Both games and responses are sequenced. The matrix games are sequenced so they gradually increase in complexity. The children's responses begin with simple statements and questions. For example: "What is in this picture?" Response: "A monkey." Later more complex responses are used. Example: "I put the red 'X' on something we sit on and the blue 'X' on something we wear."

6. The children are required to make active responses. The responses follow a direction or a question. For younger children, the rules should require them to do something, such as place a shape on the matrix board, and to correctly verbalize what they are doing and why.

7. The instructional content of the games are broken down into sufficiently small steps so the children can master them. Each step within a sequence is short, clear and meaningful for the child.

8. The games can be played by individuals who are at different levels of competence. The more advanced children can help those who need it. In some games the players can choose the level of difficulty.

9. Competition is downplayed.

10. There are no ambiguities in format or materials.

11. The games are designed to be turned over to the children to play on their own, eventually.

12. The games provide feedback, either through the game materials or from the participants, as to the correctness of each child's responses, when it is his or her turn. The games should make it natural for children to monitor both themselves and each other.

PUT YOUR HAND (Computer Version)

To the tune of a camp song

APPENDIX D

Put your hand on the computer
What is this part?
This is the monitor
The monitor part

Monitor, monitor,
Monitor part
This is the monitor part

Put your hand on the computer
What is this part?
This is the keyboard
The keyboard part

The keyboard, the keyboard
The keyboard part
This is the keyboard part

Put your hand on the computer
What's inside this part?
Inside's the CPU
The CPU part

CPU, CPU
CPU part
Inside's the CPU part

Put your hand on the computer
What is this part?
This is the disk drive
The disk drive part

Disk drive, disk drive
Disk drive part
This is the disk drive part

Put your hand on the computer
What is this part?
This is the printer
The printer part

Printer, printer,
Printer part
This is the printer part

Also can use: tape recorder, disk, tape, joystick, mouse.